

CLAIMS

1. A method of manufacturing a semiconductor device, comprising:

supplying one reactant to a substrate;

supplying the other reactant to the substrate; and

processing the substrate by repeating the above steps for a plurality of times,

wherein both or either of the reactants contains a source gas obtained by vaporizing a liquid source in a vaporization section, a flow rate of the liquid source to the vaporization section per one injecting operation is fixed, and the liquid source is controlled to be intermittently injected to the vaporization section.

2. The method of manufacturing a semiconductor device according to claim 1, wherein the flow rate of the liquid source to the vaporization section per one injecting operation is made equal to the flow rate corresponding to one supplying operation of the source gas obtained by vaporizing in the vaporization section to the substrate.

3. The method of manufacturing a semiconductor device according to claim 1, wherein the flow rate of the liquid source to the vaporization section per one injecting operation is made

smaller than the flow rate corresponding to one supplying operation of the source gas obtained by vaporizing in the vaporization section to the substrate, and the flow rate is controlled by the number of injection.

4. The method of manufacturing a semiconductor device according to claim 1, wherein the process of the step of processing the substrate is an ALD processing to form a film with a desired thickness by conducting a control of repeating for a plurality of times the steps of:

supplying the one reactant to the substrate so as to be adsorbed thereon; and

supplying the other reactant to the reactant thus adsorbed on the substrate to cause reaction, thereby forming a film.

5. A substrate processing apparatus, comprising:
a processing chamber for processing a substrate;
a container for containing a liquid source;
a vaporizer having a vaporization section for vaporizing the liquid source;

a liquid source supply pipe for supplying the liquid source contained in the container to the vaporizer;

a source gas supply pipe for supplying the source gas obtained by vaporizing in the vaporizer into the processing

chamber;

an injection drive control mechanism for controlling so as to fix a flow rate of the liquid source to the vaporization section per one injecting operation, and intermittently inject the liquid source to the vaporization section;

a supply pipe for supplying a reactant different from the source gas into the processing chamber; and

a controller for controlling so as to repeat the supply of the source gas to the processing chamber and the supply of the reactant different from the source gas to the processing chamber, for a plurality of times.

6. The substrate processing apparatus according to claim 5, wherein the controller has a function to control the flow rate of the liquid source to the vaporizer per one injecting operation so as to be made equal to an amount corresponding to one supplying operation of the source gas obtained by vaporizing in the vaporization section to the substrate.

7. The substrate processing apparatus according to claim 5, wherein the controller further has a function to make the flow rate of the liquid source to the vaporization section per one injecting operation smaller than the flow rate corresponding to one supplying operation of the source gas

obtained by vaporizing in the vaporization section to the substrate, and control the flow rate by the number of injection.

8. The substrate processing apparatus according to claim 5, wherein the controller further has a function to control so as to deposit on the substrate by using an ALD, by repeating for a plurality of times a step of supplying one reactant to the substrate to be adsorbed thereon, and a step of forming a film by supplying other reactant to the reactant already adsorbed on the substrate so as to be reacted thereon.

9. The substrate processing apparatus according to claim 5, wherein the controller further has a function to previously measure the correlation between a pressure for feeding the liquid source to the vaporization section and the flow rate per one injecting operation, and correct the flow rate per one injecting operation based on the correlation thus obtained.

10. The substrate processing apparatus according to claim 5, wherein a liquid flow meter is provided between the vaporization section and the container, and an injection drive control mechanism having a flow rate adjusting mechanism electrically connected to the liquid flow meter is installed, and the flow rate adjusting mechanism has a controller that

calculates an integrated flow rate of a certain time period or a certain constant number of injection based on an electrical signal from the liquid flow meter, monitors the integrated flow rate thus obtained with passage of time, and adjusts a change in the flow rate to the vaporization section per one injecting operation with passage of time.

11. The substrate processing apparatus according to claim 5, wherein the vaporizer is constituted as an injection type vaporizer integrally comprising the vaporization section for vaporizing the liquid source, a flow passage for feeding the liquid source to the vaporization section, and a valve element for controlling the injection/non-injection of the liquid source to the vaporization section by opening/closing the valve, and controlling the flow rate of the liquid source fed to the flow passage at controlling the valve to open by adjusting an opening degree of the valve, wherein the adjustment of the opening degree and opening/closing of the valve element is performed by the injection drive control mechanism.